NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE GENERAL SPECIFICATIONS

FOREST TRAILS AND LANDINGS

(Acre)

Code 655

Types of harvesting

Each type of harvesting method dictates a different type of harvest trails and landing system. The equipment, terrain and economics associated with the logging operation are the main factors in determining the location, extent, and type of trail and landing network to be used. The general harvest methods are:

Conventional – Chainsaw operation where trees are cut down by an individual using a hand held cutting device, typically a chain saw with transport done by a Cable Skidder, Grapple Skidder with or without a cable. This type of operation can also include the uses of livestock, and small gas powered units such as chainsaw winches and 4-wheelers. Cable yarding such as High Lead, Mast and helicopter/balloon systems often have hand-felling crews associated with them.

Mechanical – This is a mechanical operation where a mechanical arm directed by an operator uses a mounted chainsaw, circular saw or guillotine shear to remove the tree from the stump and root system.

This system has three variations. They are:

Mechanical Feller Buncher- This equipment harvests the tree and will carry the tree with the use of an accumulator to another tree for harvest. When the accumulator has reached capacity the bunch of trees are placed on the ground for future transport.

Mechanical Feller Processor- This type of harvest equipment mechanically harvest the tree, removes the limbs, and cuts the top of the tree off at a desired diameter or length of tree.

Mechanical Feller Processor Forwarder- This type of equipment functions the same as Feller Processor but will accumulate the processed trees until either its carrying capacity is maximized or the trees are transported to the landing area. This transport can be by the equipment itself or by a skidder or forwarder.

Timber Transport

Transport of timber causes the most disturbance of the forest floor of any operation in the harvest of timber products.

Numerous methods to move timber are available. For this specification the use of waterways, air transport and cable-based logging are not listed. These are a highly specialized use of transport. Contact the appropriate state specialist if you wish to recommend these transport systems. The common methods are skidding and forwarding.

Skidding- This method of transport typically lifts only one end of the tree placing some of the weight on the equipment and some of the weight on the ground. The types of equipment include Skidders. They are often rubber tired, articulated and have power to all 4 wheels. They also have both a “high lead arch” and a winch. The arch directs the winch cable into a fairlead high off the ground. One end of the trees can be then be lifted off the ground, thus placing more weight on the skidder, reducing the weight on the ground and reducing friction. A skidder may have a mounted grapple claw instead of, or may include a cable winch. The grapple can pick up trees without the operator having to manually hook-up trees to cables. Another skidding piece of equipment is a crawler tractor that uses a metal or rubber track. There may be high lead arch either mounted on the crawler or a wheeled trailer. They are slower than a skidder and not articulated. Other types of equipment include farm tractors, with and without a winch, modified 4-wheel drive trucks and ATV and snowmobiles.

The physics of the use of a high lead arch are all applicable to each type of equipment used to drag trees from the felling site to the landing area.

The second type of transport system that utilizes trails is Forwarding**.**

Forwarding – This method is a hybrid of roads and skidding. In lieu of constructing a level smooth road to each site where a tree is harvested a vehicle is used that is capable of traveling over a rough trail. A basic forwarder is a pickup truck, snowmobile or ATV that is driven directly to the site of a tree harvest and transports the entire tree or tree segments to the landing area. Typically the forwarder is a large rubber tired, articulated skidder or crawler, that has a bunk where a large volume of trees are placed during transport. Trees are not dragged and often times the forwarder has a loading mechanism such as a mechanical clamshell grapple. The forwarder is often matched with a particular type of harvesting method, usually a feller buncher or processor.

Advantage of a Skidder versus a forwarder

- faster
- can be used with a winch to gather numerous trees together at one time
- can drop the load to reduce weight and them climb out of a hole and them recollect and gather the trees and continue. (only for cabled equipment)
- can remove tall trees and long logs without having to process them on site
- needs minimal trail development widths
- needs no loading or unloading apparatus

Advantages of a Forwarder versus a Skidder

- less ground disturbance
- maintains cleaner logs for processing
- has a longer economical hauling distance
- quicker unloading capabilities
- can reduce expensive road building

TRAIL DESIGN AND LAYOUT

Planning Information needed

Type of harvest_____

Type of transport used in the harvest_____

Length and slope of Longest trail_____

Type and value of Products_____

Volume or acres of harvest_____

Harvest Area Maps, aerials and contours, stream locations, wetlands._____

Season of harvest_____

Soil Types and Limitations_____

Operator/ Logger Preferences_____

Landowner Post Harvest Needs_____

Stream locations and potential crossing points

Special wildlife habitat considerations_____

Trail and Sediment Controls

Location and Placement

Preferred locations for logging trails are:

- Previously developed trails or roads
- Tops of ridges, hills, mounds; Glacial deposits of gravel and other well drained relief in topography
- Long continuous side hills with slight inclines
- Short steep segments
- Rock outcrops and other hardened surfaces

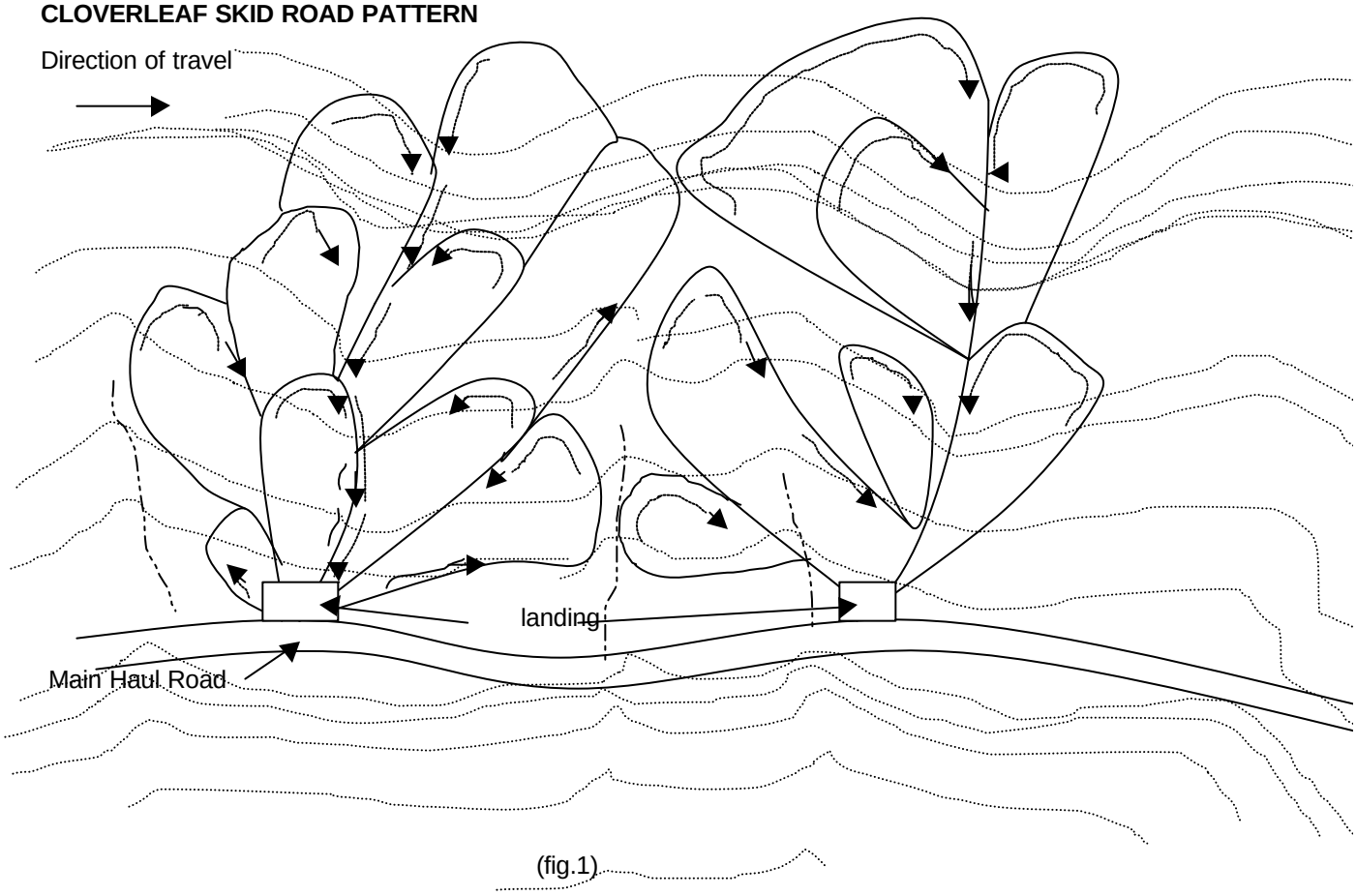
Less Desired Locations

- wetland and lowlands (except in winter logging situations)
- long steep continuous steep slopes
- toe slopes and other areas where runoff accumulates
- seasonal water courses not listed as streams
- Vernal Pools and other seasonal water bodies.

Types of Harvest Trail Layout

Three types of trail layout are shown on the following pages along with their advantages and disadvantages.

CLOVERLEAF SKID ROAD PATTERN



(fig.1)

Sketch notes- main downhill trunk lines are located on ridge tops

- stream crossing are avoided and two loops make use of the same crossing

- from the contour line notice the location of main return trails on the tops of ridges

Cloverleaf or nested loop trails are typical of hillside logging where the haul road is located below the flow of the timber. This could also be reverse with the haul road being on the top of the ridges and the trails reaching out below. In either situation the main return trail to the landing is a direct route which is straight and located where the trail can be traversed continually with minimal impact.

Advantages- This type of layout enables loads to be skidded out of the operation area without the need for two way traffic. It allows the operator to accumulate wood products and then utilizes a main trail for a return trip to the landing

Disadvantages- The long curves tend to cause wood products to roll down hill and damage residual trees next to the trail.

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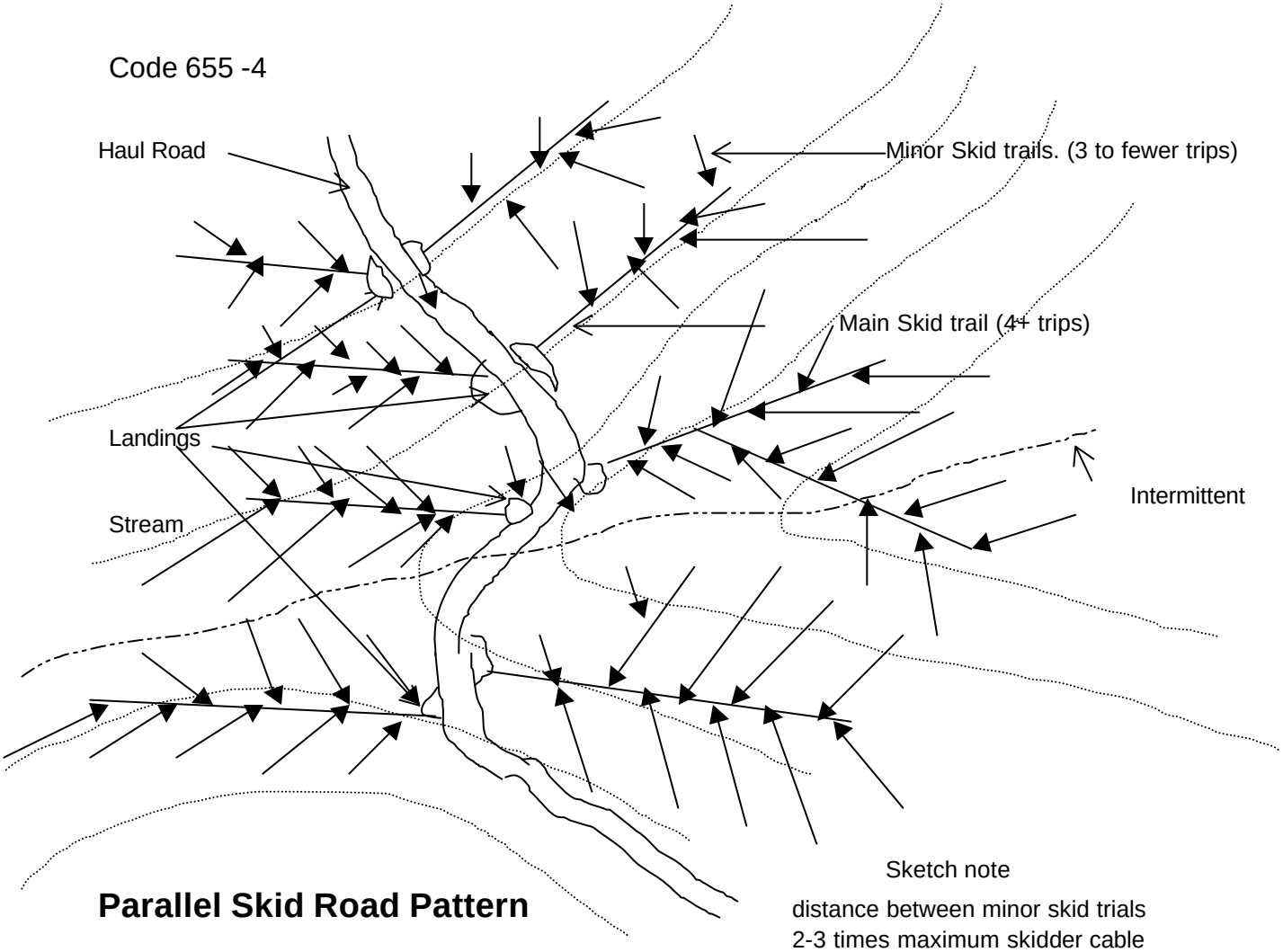

Parallel Skid Road Pattern

(fig.2)

Sketch note

distance between minor skid trials
2-3 times maximum skidder cable length

main skid trails located on contour these are the most erosive

minor skid trails are those located on steeper more critical areas (limited amount of travel)

Parallel skid road patterns are typical for a variety of conventional and mechanical harvesting systems. These types of operational layouts are systematic and are efficient in the use of a main haul road. This system is useful when a haul road is in a central location in relation to the harvest area. This type of layout provides for many small landing areas and minimizes the distance traveled by skidders to the landing area.

This type of layout can be used for both clear-cutting and for selective/thinning operations. Streams, rock faces, steep slopes are avoided by the use of minor and main skid trails. Note that the need to cross streams are minimized and can be avoided completely.

Disadvantages - The main disadvantage of this type of layout is the large number of landings and the use of the main skid trails for two way travel, which slows the rate of travel by equipment if more than one skidder or forwarder is used. This is overcome by having many active logging areas instead of one.

Advantages -This type of layout works very well for cable skidder operations where directional felling and the efficient use of the skidder winch increases the chainsaw operator productivity.

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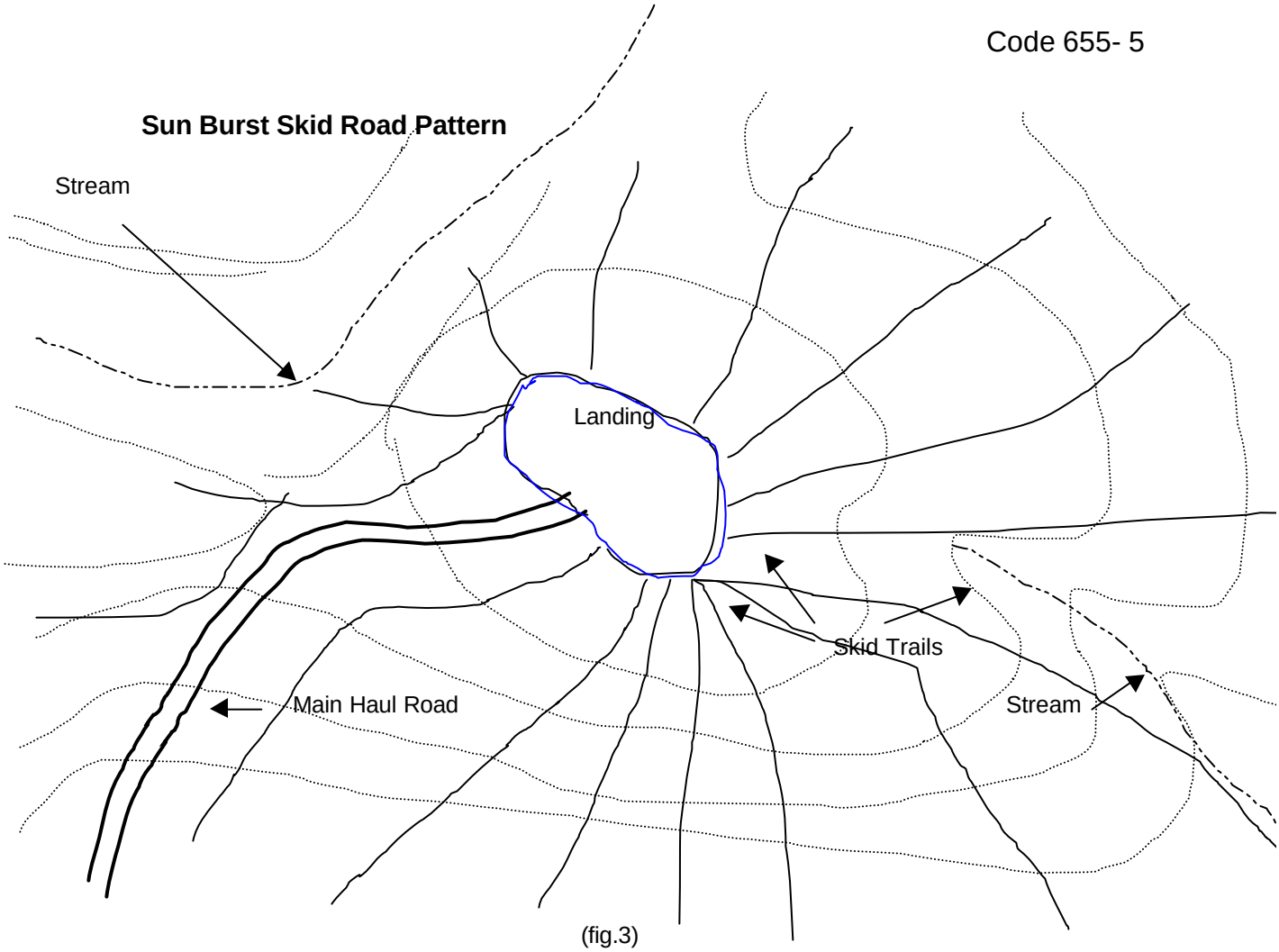
Sun Burst Skid Road Pattern



(fig.3)

Sketch note: - landing is placed on the top of a hill

- haul road is placed on a ridge top
- skid trails do not cross or run on haul road

Sunburst logging trail placement is very common on steep terrain as well as very common on clear-cutting operations. This type of placement is also common for whole tree mechanical harvesting where the landing serves as a staging area for a chipping facility. Often landing areas are connected by haul roads.

Advantages - This type of layout improves logging equipment efficiency. The skid trails are very direct with few curves and turns. Equipment efficiency is maximized with the use of grapple skidders and forwarders. The constant dragging of trees up hill minimizes soil being swept down hill, which creates a sediment problem at the landing. This type of layout is particularly efficient for clear-cutting and provides a central area for reforestation efforts if needed.

Disadvantages - Concentrates equipment travel to one spot. If landing is below the logging area, water, soil and wood debris are also concentrated to one spot.

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LAND AND TRAIL PLANNING PROCESS

KEYS TO PROPER DESIGN AND LAYOUT

OPERATIONAL CONSIDERATIONS

1. understanding of logging method being used
2. knowledge of products being harvested
3. daily and weekly productions
4. equipment limitations
5. season of harvest
6. on site processing
7. waste and by-product production and removal
8. landowner and operator contracted agreements

SITE CONSIDERATIONS

1. Soils
2. Topography
3. Water courses, and bodies
4. Forest conditions
5. Wildlife and Culture resources
6. Authorized and nonauthorized nonforestry uses: Hunting, snowmobiles, gathering, recreational trails etc.

SOCIAL AND ADMINISTRATIVE CONSIDERATIONS

1. Adjoining landowner concerns
2. State and local regulations and permitting
3. AK DOT, road weight limits

SILVICULTURAL CONSIDERATIONS

1. Regeneration requirements
2. Areas of advanced regeneration
3. Prevailing Wind direction
4. Natural seed sources

DESIGN PROCESS

1. site visit
2. paper layout/planning map
   a. identify property lines
   b. identify harvest areas
   c. identify road system access
   d. identify 'no' harvest areas
      - stream zones
      - non-cut areas
      - wildlife corridors and areas
      - riparian forest buffers and set backs
   e. identify all existing and past trails
   f. identify all area with soil limitations
      - wetlands, seeps and drainages
      - steep slopes
      - high erosion potential
   g. identify all areas with good trail and landing potential
      - ridge tops
      - convex slopes
      - bedrock control slopes
      - potential hard bottom stream crossing
   h. located potential landing areas
   i. located potential trails
3. Evaluate and locate trails and landings on site
4. Walk entire trail and landing locations after layout with operator and landowner, evaluate for logging efficiency, ecological impact and for post harvest regeneration, recreational uses, trail and landing closures and reclamation and future harvest use.
5. Repeat any part of the process as necessary

Trail Width and Length

Width

Trail width should only be as wide as needed to transport the products being removed from the forest. The minimum with of the trail is by default the width of the largest piece of equipment that will traverse the trail. An allowance for safety of the operator and protection of the equipment often calls for the addition of 3 feet on each side of the equipment. So a practical standard of 6 feet plus the width of the largest piece of equipment is often acceptable. Maximum width depends on may factors, but should be minimized to the fullest extent if the future land use is to remain as forest. Trails that will be convert to roads, recreational trails and other landuses should be design for both the initial use and the final use.

Turning Radius

Most equipment used in logging has a very tight turning radius (requiring minimal space to turn). In the process of extraction of forest products, the turning radius is greatly increase due to the material being towed or dragged behind. A general rule in designing of turns is to allow the amount of radius need to complete the turn with the minimum amount of effort needed, and the minimum amount of damage impacted on the material being extracted. Damage to the residual trees is expected and should be used to the planner's advantage. An old trail design saying goes: It is better to hit on tree 100 times, than it is to hit 100 tree once. Leave bumper trees in place that can aid the operator "swing" a load around a tight corner. This type of tree is placed (or left in place) on an inside corner of a curve. If excessive trees are going to be damaged or the landowners wishes minimal damage to residual trees and narrow trails; work with the operator to reduce the length of the materials being extracted and this will decrease the damage. This will also decrease logging efficiency.

Length

The length of trails is dependant on the cost effectiveness of the harvest operation. In general the rule of timber harvesting economics is:

Trails are the lowest construciton costly of all transportation means and the equipment used on trails have the highest per unit/ per mile cost of in timber harvesting. At the other extreme, paved roads have the highest construction cost, but on a per mile per unit transported, trucks used to haul logs on these roads have some of the lowest per mile, per unit removed cost.

A generalized progression of cost from lowest to highest are show in the following table.

Table (a)

COMPARISON OF CONSTRUCTION COST VERSUS COST OF PER UNIT PER MILE TRANSPORTED

Type of road/tail	Typical type of Transport
Lowest construction	***Highest cost***
Walking trail	Arm load of wood
Animal trail	horse logging
"Skidder trail	Skidder
"Cat" crawler trail	Dozer or Crawler
Forwarder trail	Forwarder
Mechanical harvester trail	Feller-buncher
"Bladed" dirt	4-WD Truck
Stumped and Graded Trail	multi axle log truck
Gravel surfaced trail	multi axle log truck
Local borough road	semi tractor (seasonal)
State DOT gravel road	semi tractor (seasonal)
paved limited weight road	semi tractor (seasonal)
State Highway	Multi trailor
Highest Constuciton Cost per mile	***Lowest Cost per unit per mile***

Arrow indicated low cost to high cost

Construct trail lengths to maximize the efficiency of the harvest operation or to meet the other objectives of the landowner and to meet the quality criteria established for NRCS Resource Management System Planning

Trail Placement relative to streams.

When trails need to cross streams and creeks, the approach to the

stream should be as close to perpendicular (90 degrees to the stream) as possible. Select steam crossing sites that:

-Have hard stable dry approaches.

-Have a hard stream bottom if being planned as a ford crossing.

-Allow for temporary bridge or culvert placement and removal.

-Allow for any water captured in the trail to be diverted well away from the stream into an adequate buffer or filtration area.

When trails need to be parallel to streams and other water bodies; a buffer needs to be placed between the road and the stream. Often stream banks are the best and most gradual approaches up hillsides and ridges. Evaluate the slope, not of the road but of the adjoining land.

Placing the road on a bench or slope break is often a preferred location. Select a setback that is appropriate to situation.

Table (b).

Slope of Land Between trail and water course	Width of Filtration Strip
Percent	Feet
0	35
10	55
20	75
30	95
40	115
50	135
60	175

Erosion and Sedimentation Control

A number of treatments can be implemented in order to control sediments and erosion. These treatments also help maintain trails during and after the harvesting operation as well as assist in keeping wood products free from rocks, and soil which can lower value at the processing facility.

Techniques designed for forest harvest roads may not be applicable for harvest trails

Skidding equipment would quickly destroy a gravel road surface and likewise a wheeled logging truck would quickly destroy a rough log skidding trail.

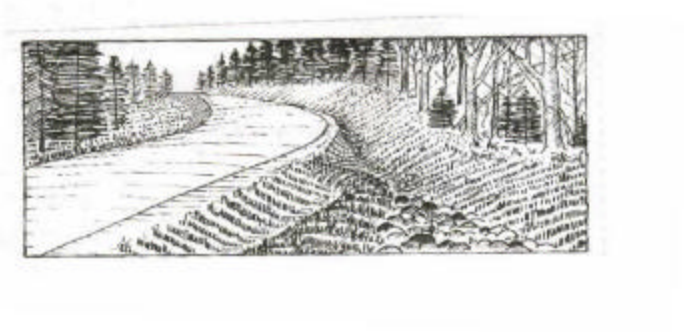
A particular treatment for erosion control may aggravate the condition being treated if employed in the wrong area at the wrong time.

Water Turnouts. Cross-drains, drive-through water bars.

Turnouts are small ditches that take concentrated flow found in trails and channel it into the forest. (fig 5.)

They are: Less than 10 inch deep

-Created with minimum ground disturbance.
-Created with light equipment or hand tools.
-Placed where maximum filtration to a stream can occur.
-Placed upslope from trees located adjacent to the trail, to channel water over the tree roots in order to limit head cutting.



(fig.5)

Temporary Measures

During periods of heavy precipitation temporary water diverting structures can be installed when operations are halted due to stormy weather. Examples of these are.

Staked Hay Bale diversions that divert water off the trail.

A large advantage of this temporary treatment is that the hay bales can be utilized for more than one event and that they can be also used for trail revegetation and stabilization. Care should be taken that hay does not introduce plant species that may be noxious or invasive.

Siltation fencing. The fence materials can be installed similar to the hay bales and used to divert water off the skid trail.

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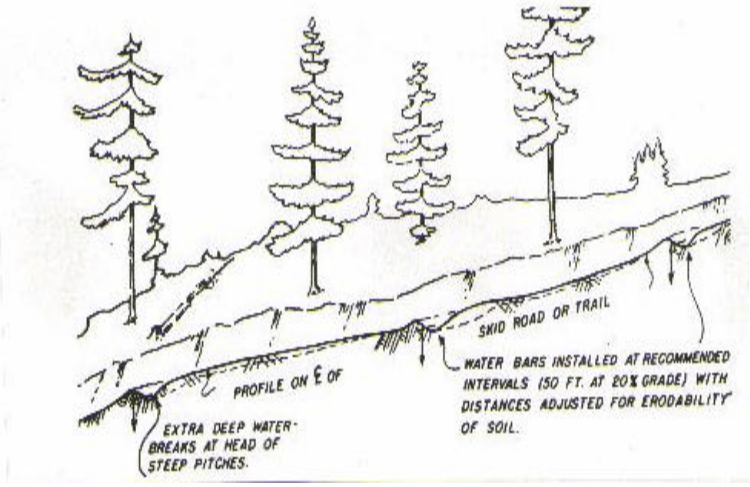
Temporary measures should be removed when use is not needed, especially if there is a possibility of future problems with their installation or placement

Permanent Measures

Water bars



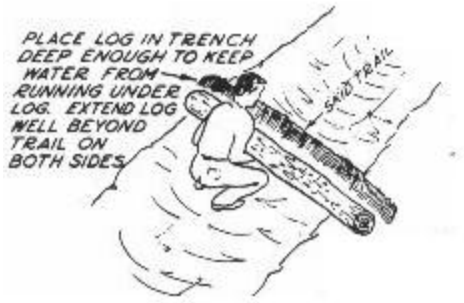
(fig 6)

Waterbars are diversions typically installed on roads that are not intended for continued use. All surfaces should be stabilized with either temporary or permanent vegetation. Discharge slope should be at a minimum 1% but should not exceed 5%. See figures 6 –9 for typical water bar installation.

Log Diversions used as a Waterbar.

(fig. 7)

A variety of waterbar treatments can be applied using locally available materials.



(fig. 8)

(fig. 9)

Broad Base Dips

These are shallow and broad dips in the road or trail surface that are designed to be driven through on a regular basis. Often times they are hardened with crushed stone or rock to increase their life span.

Spacing between broad-based dips is determined by the formula.

Spacing = (400/slope %) + 100 feet

Example (400/20%) + 100 = 120 feet

The discharge slope (slope going from the top towards the bottom of the water bar) is calculated as:

Discharge slope= 1.2 x slope %

The down slope grade (from the bottom of the dip to the lower downgrade road section) is 3 % . Typically a broad-based dip has a depth of 8 to 10 inches. The out slope, (slope that the water is directed off the road at the bottom of the dip should not exceed 5% but should be greater than 3%. A design feature of a broad based dip is that no berm or soil is placed in order to create the down slope grade. It is created only by excavation.

Fig. 10

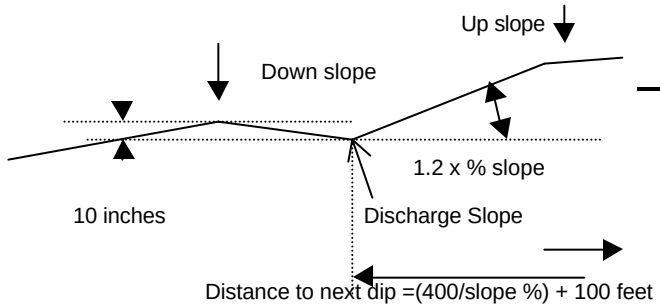
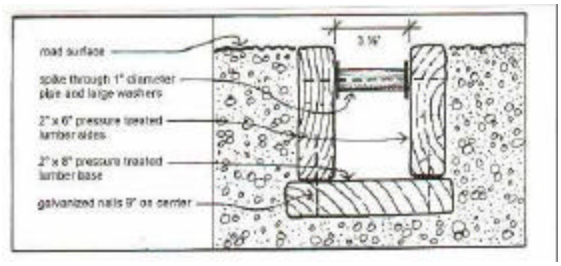


Table (b)

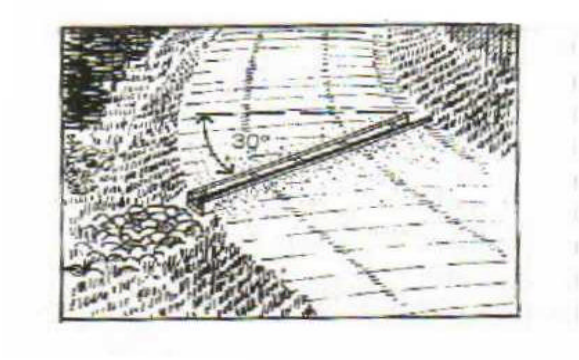
Grade of Road	Distance between waterbars
Percent	Feet
1	250
5	135
10	80
15	60
20	45
25	40
30	35
40	30

Open top culverts

Open boxes that channel water from one side of the road to the other as well as collect surface water have been used on a limited basis when water amounts are minimal and where traffic is limited. These are often maintenance intensive and have been replaced by metal and plastic culverts with proper road crowning.



box culvert (fig 11)



placement (fig 12)

Installation of permanent structures and treatments

The following guideline has been developed for the spacing of waterbars and other structures.

LOG LANDINGS

Log landings or areas that are used for the concentration and storage of logs, timber and other forest products are necessary for the efficient harvest of forest products.

Landings need to be adequately sized for the operation. Sizing of the landing is based on

-Number of products being harvested

-Size of these products

-Time anticipated for onsite storage

-Ease of entering and exiting the landing with full on site storage

- Ease of disposal of wood debris/slash during the harvesting process.

Landings need to be located in well-drained areas that allow for easy access to both the logging area and the adjoining road

Landings should be stabilized or reclaimed, as needed based on landowners requirements. Plan on using landing areas for multiple uses such as trailheads and for emergency vehicle parking.

In some areas where gravel or other high valued road and landing building materials are rare, these materials can be reclaimed and used at another harvest location.

Landings should have facilities for trash and rubbish collection. Fuels and lubricants as well as other equipment maintenance tools and supplies should be stored properly.

CLOSURE AND LONG TERM MAINTENANCE

Listed are three types of road closure/road site restoration categories (also applicable to landings)

Category I – Road and Trail Access Closure

This closure involves either the placement of a permanent or temporary barrier that prevents access to road or trail. This access can be either selective or non-selective with respect to what is allowed on to a road or trail. For example a road closure may bar roadway vehicles but allow for recreation vehicle use. It may be selective to only allow for foot traffic and not allow for any motorized-wheeled traffic.

Planning considerations include gating access with key or combination locks that allow for motorized traffic for safety, maintenance or future use. Interruption of access may cause a change in traditional use and potential safety issue.

Category II – Removal of Structures

A category II road and trail closure involves the removal of bridges, culverts and other structures. The structures removed can yield improved stream habitat and riparian area as well as limiting travel. The removal can be designed to prevent passage or to permit low water passage by using hardened stream bottom crossings.

Category III – Road Bed Removal and Restoration. (also applies to landings)

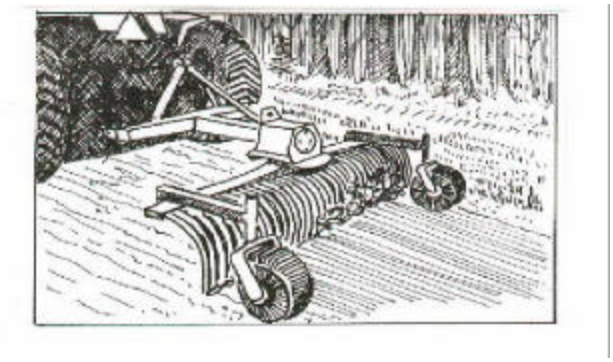
This method removes all structures, road building materials and provides for the restoration of the area to a natural state.

Operation and Maintenance

Proper maintenance is vital to the longevity of all types of roads and trails. Properly constructed trails have minimum maintenance need but periodic maintenance is necessary.

A well maintained and traveled gravel road will have a wearing of the surface of between ¼ to ½ inch per year dependent on surfacing materials and traffic. Periodic regrading is necessary to remix the surface materials and increase the life span of the road surface. Regular inspection of culverts, bridges and other water drainage and control structures will enhance the life span of the road and the structures.

As the wear surface diminishes additional material may need to be added to maintain the road crown and travel surface.



(fig.13)

Rock rakes are an effective method for light grading and crown maintenance (fig. 13)

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SAFETY

Proper attention to safety concerns will make the road safer for all users. Proper signage indicating bridges, curves and other irregularities will improve user safety.

Where logging roads and trails exit onto public roads, care needs to be taken to allow for the “cleaning” of vehicle treads before entering on the public way. This is accomplished by providing a segment of level, dry and compact surface that allows materials to fall off of tires before falling on the public road. These areas are also ideal for load checks and for vehicle safety inspections. Mud or other debris that falls on public road ways become a safety hazard as well as nuisance for other vehicles. A clean run-up or run-out area also decreases dust that obscures visibility and be comes a safety concern for logging vehicles leaving a work site.

Signage on the public way also is important for informing traffic of the exiting logging traffic.

Land Use Planning

While roads, trails and landings are necessary to the success of most forest uses, their development takes land out of production.

For guidance, if the total land use that is occupied by trails, roads and landings is less than 5% then you may wish to evaluate the efficiency of the logging and harvesting operation. If the percentage of land that is allocated to roads, trails and landings exceeds 10%, then there may be an excess of these land uses and land may be placed out of production unnecessarily.

These are only guidelines and the type of operation, and equipment being used will have an effect on the amount of land being allocated to roads, trails and landings.

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